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ABSTRACT

The systematic study of reading dates form the beginnings of experimental psychology in the late nineteenth century. Cattell measured reaction times for naming letters and words, investigated parallel processing, and compared legibilities of letters and printing types. From the end of the 1880s to the publication of Huey's 1908 text, reading processes were a central focus of experimental psychology. After this period, however, the influence of behaviorism turned experimental psychologists away from the investigation of mental processes, while educational psychologists became preoccupied with testing and measurement. A revival of experimental work occurred in the late 1950s. With the current rise in popularity of information processing, studies of reading once again occupy a central role in psychology. Almost all of the problems attended to by the first researchers remain unresolved today: control of eye movements, the strategies involved in word recognition, the amount and types of overlapping processes, the role of subvocalization, the nature of the eye-voice span and the optimal methods for reading instruction. How to translate research results into educational practice also still remains a problem.
(Author/HKM)

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Theoretical Paper No. 56

A HISTORY OF RESEARCH ON READING

by

Richard L. Venezky

Report from the Project on
Conditions of School Learning and Instructional Strategies

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Wisconsin Research and Development
Center for Cognitive Learning
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ABSTRACT

The systematic study of reading dates from the beginnings of experimental psychology in the late nineteenth century. Cattell, an American working in Wundt's laboratory in Leipzig, measured reaction times for naming letters and words, investigated parallel processing, and compared legibilities of letters and printing types. He also reported for the first time on many problems still current in experimental psychology, including the ecological problem and the word effect. From the end of the 1880's to the publication of Huey's 1908 text, reading processes were a central focus of experimental psychology. Cues for letter and word recognition, and eye-voice span, the nature of comprehension, and subvocalization were among the topics investigated.

After this period, however, the influence of behaviorism turned experimental psychologists away from the investigation of mental processes, while educational psychologists became preoccupied with testing and measurement. Research on reading processes was left to the occasional experimenter who worked without the professional interaction and competitiveness of the earlier period.

A revival of experimental work occurred in the late 1950's, prompted both by governmental concern for the quality of education, as reflected in the Cooperative Research Act of 1954, and by experimental psychology's renewed interest in mental processes. With the current rise in popularity of information processing, studies of reading once again occupy a central role in psychology. But how to sustain this interest and translate results into educational practice are as problematical today as they were 75 years ago.

I

INTRODUCTION

Writing a history is a highly subjective and often pretentious task of passing judgment on the importance of various publications, and imposing on them relationships and divisions perhaps not intended or desired by their authors. The historian's responsibility, however, is to do exactly this: to organize data in a manageable and readable fashion; to do otherwise is to produce a bland and uncritical tabulation of who claims to have done what when.

> To object to labels and periods and say that historians make them up, hence they are false is a cliche that is itself false to the way things happen, besides amounting to a failure of imagination. Without divisions of time, groupings of men, aggregates of ideas, the historian would be reduced to unreadable, unrememberable chronicling [Barzun & Graff, 1957, p. 157].

The historian's task for reading research is especially trying. The published output is staggering in size--over 4,000 articles chronicled between 1884 and 1966[1]; it originates from almost every locus within education, the humanities and the social sciences, and from many areas beyond these--including ophthalmology, typography, and engineering. The quality of this research is highly uneven and many important early publications--especially those from the nineteenth century--are difficult to locate, leaving the historian at the mercy of secondary accounts.

In spite of these difficulties, however, the time is ripe for a dispassionate and thorough accounting of the last 100 years or so of reading research. Literacy has again become a national issue. The volunteer army, open admissions at colleges and universities, and industrial recruitment of minorities have all brought into dramatic focus what a National Reading Council study by Louis Harris and Associates (1970) concluded five years ago--that many adults in the United States, perhaps as many as 30 million, are at or below a marginal survival threshold in literacy.

Reading became an official government concern in 1970 with adoption of the Right to Read Program; it has continued to receive high funding priority in the National Institute of Education, which

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[1] The chronicling has been performed yearly by various persons--beginning with William S. Gray (1925)--and published in trade journals (in the Reading Research Quarterly since 1965). See further Summers, 1968.

has taken over the funding of most educational research from the Office of Education. Among experimental psychologists reading has been receiving unprecedented attention--primarily because certain basic reading processes are amenable to information processing experiments. Issues of major psychology journals are seldom without at least one article on reading, and a new major text on the psychology of reading (Gibson & Levin, 1975) has recently been published.

Such an overwhelming revival of reading research requires a proper understanding of the antecedents of present-day knowledge if duplication and wasted effort are to be avoided. Bits and pieces of this history can be gleaned from disparate publications of the last 20 years, but the last attempt at a comprehensive history of reading research was published 50 years ago (Gray, 1925). Among other sources which review earlier studies, Smith (1965) deals primarily with teaching methodology; her treatment of research is spotty and lacking in critical judgment. Mathews (1966) is competently researched and highly readable but, like Smith, is concerned mostly with teaching. Anderson and Dearborn (1952), although not historically oriented, review a significant fragment of the older studies. The best single source for nineteenth and early twentieth century studies is Gray (1925). But as Gray himself points out, he is concerned primarily with the British and American research since many of the European publications were not available to him at that time. He does, however, mention some European works, although they are not included in his bibliography.[2]

The history which follows is a synthesis of works from a variety of sources, filtered and molded by personal perceptions of the relevance and importance of these works to an understanding of the reading process. It is not a history of all research on reading, but only of investigations on basic reading processes, including such areas as letter and word recognition, eye movements, and reading speed, but excluding for the most part testing, teaching methods, materials, and most of the work on disabilities.

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[2]The number of studies which Gray reports for various periods up to July 1924 has become the basis for a modern day cabalism that is both misleading and inaccurate. Duker and Nally (1956) and Mathews (1966) ignore Gray's omission of the European works, and present his figures as absolutes, without reservation, for all reading research. Smith (1965) qualifies one of these counts as being based on investigations in England and in the United States: "By 1910 only 34 studies had been reported altogether by investigators in England and the United States [p. 154]." Even if Gray's caveat had been noticed, his figures would still not accurately reflect the research done during this period because Gray was selective, not exhaustive, and he was primarily interested in pedagogical matters. Huey (1908), for example, cites at least three dozen works in English for the period up to 1908 which Gray did not include. Perusal of the first 15 volumes of the Psychological Review (1895-1908) reveals further works on reading which were not counted by Gray. Finally, the emphasis on absolute numbers, especially with the modifier "only," gives a mistaken impression of paucity. Taken in perspective, a relatively large amount of material was published during this period.

II

BEGINNINGS

The earliest experimental study of reading was performed at the end of the 18th century by the director of the French National Printing Office (Anisson) and reported before the Societé Libre des Sciences, Lettres et Arts of Paris in 1800.[3] Two one-page specimens were printed, one in a modern Roman style (Didot) and one in a late Renaissance style (Garamond). Experts (of an unspecified nature) then attempted to read each page at varying distances. By this method the Garamond type was found to be more readable. In 1827, Charles H. Babbage, an English mathematician whose analytical engines were precursors of present-day computers, used a majority vote to determine the relative influence of different shades of paper on readability. Babbage also experimented with the readability of numbers printed in different styles. But Babbage's interests, like those of Anisson and others who experimented during this period, were on the properties of the printed page which affected readability, and not on the reading process itself.

Systematic study of human reading behavior began at the same time and in the same place that experimental psychology began--Wundt's laboratory in Leipzig in the late 1870's. Wundt accepted the chair of philosophy at Leipzig in 1875 and within four years had founded the world's first experimental psychology laboratory. Foremost among the laboratory's initial interests were sensation, perception, and reaction experiments, but it was only the last of these which led to a focus, however brief, on reading. Reaction experiments were part of psychometry, which had as its goal measuring the rapidity of mental events. Eye movements and oral responses to briefly exposed stimuli provided a means, through the subtractive procedures originated by Donders, for determining the speeds of various mental events.

The central figure in the reading studies at Leipzig was not Wundt but Cattell, an American who was Wundt's first assistant and who spent three years in Leipzig, receiving his Ph.D. in 1886. Cattell was especially interested in individual differences. He used reaction times to explore such variations, and found reading

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[3] Information on this and the other early typographic studies is derived from Wiggins (1967) and Spencer (1969). A historical survey of studies on legibility can be found in Pyke (1926).

behaviors extremely convenient for exact measurements. Reading per se was not Cattell's major concern, yet his work on letter and word recognition, legibility of letters and printing types, and on stimulus intensity formed the groundwork for most basic reading research of the next 30 years.[4]

Cattell's most famous article, "The time it takes to see and name objects," (1886) reports two of the most influential reading experiments to come out of Wundt's laboratory. In the first, Cattell mounted letters on a rotating drum so that they could be observed only while they were passing behind a narrow slit. When a single letter could be seen, the naming time was about one-half second. When, however, the slit was widened so that the second letter came into view before the first disappeared, the naming time dropped to one-third to one-fifth second, and continued to decline as the slit was widened so that more letters came into view at once. Of the nine subjects (university teachers and students), four read letters faster when five were in view at once, but were not helped by the sixth; three were not helped by the fifth; and two were not helped by the fourth. This demonstrated not only that several processes could go on in parallel, but that the simple subtractive model for determining the speed of mental events was not always applicable. (The overlapping of seeing and naming which takes place in this study depends on the eye-voice span--a phenomenon first reported for oral reading by Quantz [1897], but not investigated extensively until Buswell [1920].)

In the second study, Cattell measured the time required for reading aloud connected and unconnected words and letters. He found that subjects required twice as much time to read aloud unconnected words as connected ones (i.e., sentences), or unconnected letters as connected ones (i.e., words). This result was ignored until the 1950's, when information theory applications prompted experiments based on reading and memorizing sentences in successive approximations to printed English.

In an earlier article, Cattell (1885) demonstrated that at a fixed exposure time, skilled readers could recognize two unconnected letters or two unconnected words. This result contrasted with claims by Valentius that letters were perceived separately in word recognition and it became the basis in later years for the whole-word approach to reading instruction.

Besides his work on basic reading processes, Cattell also had a large indirect influence on reading through his work on mental tests and measurements. After leaving Leipzig, Cattell worked for a short time in Galton's anthropometric laboratory in London where Galton was attempting to develop a standard series of measurements for such human traits as weight, height, and strength of pull. Cattell extended the idea of standard tests into the realm of mental processes after his return to the United States. In 1890

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[4] Many of Cattell's works have been reprinted in James McKeen Cattell. Man of Science, 1860-1944, 2 vols. Lancaster, Penn.: Science Press, 1947. In addition, his work on reading is summarized by Walter F. Dearborn, "Professor Cattell's studies of reading and perception," Archives of Psychology, 1914, 30, 34-35.

he introduced the term "mental tests" and proposed a series of 10 tests for gathering normative data throughout the country (Cattell, 1890). In the conclusion to this article, Cattell suggested that through mental tests "Experimental psychology is likely to take a place in the educational plan of our schools and universities [Cattell, 1890, p. 380]"--a remarkable understatement, as it turns out.

Cattell's legacy to reading research was not only his research but also his students, who included E. L. Thorndike, R. S. Woodworth, W. F. Dearborn, and A. I. Gates. His concern for the science of psychology led him to consider many of the epistemological questions which experimental psychologists are still wrestling with today, particularly in reading research. A typical example is found in the introduction to "The Time It Takes to See and Name Objects," where he cited as one of the three major problems in experimentation (i.e., psychometry) what has come to be called the "ecological problem."

> The other difficulty lies in the fact that times measured are artificial, not corresponding to the times taken up by mental processes in our ordinary life. The conditions of the experiment place the subject in an abnormal condition, especially as to fatigue, attention, and practice [Cattell, 1886, p. 63].

Although Cattell was the most imaginative and productive figure of this period, a number of others also made significant contributions. Javal (1878), a French ophthalmologist, observed that eye movements in reading were discontinuous, describing them as *saccades*, from which the term saccadic was derived. Earlier, Valentius had found that a ". . . reader perceives from three to four letters simultaneously in from 100 to 270 thousands of a second [Gray, 1925, p. 2]."

Romanes (1884), a friend of Darwin who extended the concept of evolution to the measurement of individual differences in animals and humans, reported what appears to be the first comprehension test ever devised. Adult readers were given a ten-line paragraph to read during a fixed time period, after which they wrote down everything they could remember. Romanes found a 4-1 difference in reading rates among his subjects, and observed that the more rapid readers recalled the most. He also noted that while recall was imperfect after the first reading, on a second reading many non-recalled items were immediately recognized as familiar. This difference between recognition and recall he attributed to the "latency of ideas."

III

THE PRODUCTIVE YEARS

Towards the end of the 1880's, about the time of Cattell's departure from Wundt's laboratory, reading moved to stage center in experimental psychology. In a period of about 20 years--up to Huey (1908)--many of the problems being investigated today were either examined, described, or suggested, including the cues for letter and word recognition, the eye-voice span, parallel processing, the nature of comprehension, subvocalization, and the word effect.

The investigations and observations of this period, hardly thorough or reliable by modern standards and often based upon the performance of a single subject, nevertheless comprise the most creative and fruitful analysis of the reading process ever undertaken. They were unrivaled for quality until the late 1950's, when psychologists again began to investigate reading. It is considerably more than curiosity that has led to the current interest in Huey's 1908 text The Psychology and Pedagogy of Reading. In the introduction to the 1968 reissue of this book, Kolers notes quite appropriately that "Remarkably little empirical information has been added to what Huey knew, although some of the phenomena have now been measured more precisely [Huey, 1908, p. 14]."

The most controversial issue of this period concerned the nature of perception during reading and especially the question of whether or not perception occurred while the eyes were moving. Cattell had suggested that it did, but experiments by Erdmann and Dodge (1898) and Dodge (1900, 1907) produced evidence to the contrary.[5] For those who held that vision did not occur during eye movements, a further controversy developed over the inhibitory mechanism. Dodge (1900) held that optical blurring was the cause, while Holt (1903) attributed it to a central inhibitory process. (A clear demonstration of the correctness of Dodge's position was not done until Uttal and Smith [1968].) Related to this issue was a conflict over the regularity of eye movements. Javal claimed that the eyes paused on every tenth letter in reading. Huey (1908), while not supporting the specific span of ten letters, nevertheless held that eye movements were rhythmic. Erdmann and Dodge (1898), on the other hand, stressed the irregularities in eye movements due to individual differences and to differences in reading materials. For many experimenters today, this issue remains unresolved.

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[5] As Huey points out (1908, p. 37), Cattell later acknowledged the untenability of his position.

Another major controversy centered on the cues for word perception. Erdmann and Dodge (1898) demonstrated that words could be read at a distance at which letters could not be identified. This result, which was later misinterpreted as support for a whole-word instructional strategy, was consistent with Cattell's earlier findings (1886) that the perceptual span for letters in meaningful words was considerably greater than the span for letters in random strings. Adding further support to the holistic explanation was a study reported by Pillsbury (1897) in which subjects were asked to identify words in which a letter was either omitted, blurred with an overtyped "x," or replaced by another letter. These words were exposed for brief durations and the subjects were asked not only to identify each word but to comment on any letters which were not clearly seen. Subjects tended not to report the letters which were altered and in some cases even insisted that a replaced letter was clearly seen. (Omissions were detected in 40 percent of the cases, replacements in 22 percent, and blurs in only 14 percent.)

Opposed to the whole-word school were Goldscheider and Muller (1893), who found that misreadings of briefly exposed words were more frequent if certain "determining letters" were absent than if other "indifferent letters" were missing, and Zeitler (1900), who derived a theory of "dominant letters" from studying which letters were reported most accurately in misreadings of tachistoscopically presented words. Other studies on word perception (e.g., Hamilton, 1907) supported neither a letter-by-letter theory nor a whole-word theory. The general condition of word perception theories in the early twentieth century, however, was aptly described by Huey (1908), who wrote, perhaps for the entire century: "It is very difficult to draw final conclusions concerning visual perception in reading . . . [p. 102]."

Other perceptual controversies centered on the speed of eye movements and the amount of material which could be read during a single fixation. Although the earliest work was performed in Europe, principally at the University of Paris (Javal and Lamare), the University of Halle (Erdmann, Dodge) and the University of Leipzig (Cattell), the locus of experimentation had shifted by 1900 to the eastern United States, and in particular at Yale (Judd, McAllister, Steele), Brown (Delabarre), Harvard (Lough), Columbia (Cattell), Wesleyan (Dodge), and Clark (Huey).

During the same period three major texts on the psychology of reading were published: Quantz (1897), Dearborn (1906), and Huey (1908). Quantz's "Problems in the psychology of reading," which summarizes a series of studies done in Jastrow's laboratory at the University of Wisconsin, is the first systematic study of the reading process ever published, and foreshadows much of today's work by positing a stage-by-stage reading model. The studies cover the eye-voice span, speed of reading, eye versus ear mindedness, lip movements during silent reading, and quickness of visual perception. Quantz, as mentioned above, was the first to publish on the eye-voice span, using as evidence data gathered from a single subject. "In reading aloud, furthermore, if it is to be intelligent and intelligible, words must be perceived some distance in advance of

those which the voice is uttering. The rapid reader has the greatest interval between eye and voice . . . [Quantz, 1898, p. 436]."[6]

Of more importance for present-day work than specific results are Quantz's attempts to formulate stages for information processing during word recognition. The model he offers for naming a word includes:

1. Arrival of impression on the retina.
2. Transmission of impression to the sight center, where it becomes a sensation.
3. Conversion of the sensation to a perception (which occurs sometime after the stimulus is cut off).
4. Association between object and name.
5. Motor response (naming).

Although this description lacks definite reference to iconic storage and short-term memory, analogues to these constructs are implicit in references elsewhere in his publication to "after-images" and "primary memory images."

Quantz's eye-voice span is one of the several examples of overlapping processes observed in the nineteenth and early twentieth century. As mentioned earlier, Cattell's report on his letter-naming experiment is the first publication on this phenomenon. Bryan and Harter (1899) reported on an ear-hand span in receiving telegraph codes. They also reported (secondhand) on the existence of a finger-voice span in the oral reading of Braille. Book (1908) found overlapping processes in typewriting (eye-hand span); these were not explored extensively, however, until Butsch (1932).

Both Dearborn (1906) and Huey (1908) attempted comprehensive treatments of reading, but Huey was by far the more successful. He treated not only the experimental work on perception and rate of reading, but also discussed at length the function of subvocal speech, the nature of meaning, and the history of reading and reading methods. Finally, he attempted to relate research to pedagogy, especially in the visual domain: appropriate type sizes, lengths of printed lines, etc.[7] The book's major virtue, as summarized by a reviewer in 1909,

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[6] For a review of eye-voice span studies, see Anderson and Dearborn (1952, pp. 122-128) and Schlesinger (1968, pp. 27-29).

[7] The similarities between formatting customs today for children's books and the suggestions made by Huey on this topic, drawn from his research experience, make it especially difficult to accept Fries' totally negative view of eye movement research. "In spite of the great number of studies dealing with eye movements (or better 'eye pauses'), very little of a positive nature has been contributed from these studies to our understanding of reading ability and to our knowledge of how to develop it in either children or adults [Fries, 1962, p. 30f]."

is no less important today: "Probably its most striking feature is the tempered, yet progressive mixture of science and practice [Buchner, 1909, p. 149]."

During this period work also continued on subvocalization (Secor, 1900), word-blindness or dyslexia (Morgan, 1896), acuity as a function of retinal location (Ruediger, 1907), comprehension and the testing of reading ability (Whipple, 1908), and of course on the span of perception (or apperception). Typical of work in this latter area is a study by Griffing (1896), in which subjects from grade one through college attempted to identify briefly exposed capital letters. Each exposure contained six randomly drawn letters, arranged in two rows of three letters each. Exposure durations were one-tenth of a second and one second; each subject received ten trials at each exposure duration. Subjects showed continual improvement with increasing grade level, and the advantage of increased exposure time decreased steadily over the same age span. Although Griffing's main concern was attention, he was not willing to attribute the entire experimental effect to this factor. He was clearly aware of immediate memory problems, mentioning the "ability to receive and retain a number of simultaneous retinal impressions [Griffing, 1896, p. 231]."

IV

THE TRANSITION TO APPLIED RESEARCH

Shortly after the original publication of Huey's book, the emphasis in reading research turned from basic processes to teaching and testing. These were, in Boring's terms, in the "spirit of the times." Individual differences and learning disabilities were incorporated into Dewey's progressive education, and from this came a need to measure progress objectively. By 1911 Binet's intelligence test had undergone two revisions, Volume 1 of the Journal of Educational Psychology had been issued, Thorndike's handwriting scale had been published, and the whole-word method of reading was in its ascendancy. During the period from 1908 to about 1920, a movement away from basic research occurred, with experimental psychologists shifting their interests to behaviorism and thereby abandoning the field of reading research to the educational psychologist, to the educator, and to a new entry from within education, the reading expert.

For almost 40 years afterward, basic research on reading received little emphasis. Some work of high quality did occur during the transition, including studies of letter legibility (Dockeray, 1910), reading speed (Pinter, 1913b; Mead, 1915; Oberholtzer, 1915), subvocalization (Pinter, 1913a), and the eye-voice span (Buswell, 1920; Judd & Buswell, 1922). But the intensity and excitement of the earlier period was lacking and did not reappear until the late 1950's when perceptual and cognitive psychologists re-entered the field of basic reading research. Vernon lamented in 1931, "There has been little experimental work since the publication of Huey's Psychology and Pedagogy of Reading upon adult perception in reading, and the majority of the work upon children's perception in reading, though possibly of much pedagogical value, has been too disconnected and uncontrolled to provide results of much reliability or psychological interest [Vernon, 1931, p. xiv]." Studies on the eye-voice span (Tiffin, 1934; Fairbanks, 1937) and on eye movements (Tinker, 1936, 1946) continued to appear in the thirties and forties, but the major emphasis in reading research shifted to applied areas, and particularly to diagnosis and assessment, as characterized by the studies of Gates and his colleagues.

Gates (1921) explored the relationship between reading ability and intelligence in elementary level children through measures of oral and silent reading (including both reading speed and comprehension), vocabulary knowledge, and intelligence, and drew two important conclusions from the resulting correlation matrix. First, he found no evidence in the data to justify the notion of a general reading

factor; instead he found evidence for a number of moderately independent factors. Second, he found that the correlation of reading ability with intelligence increased from grade to grade, a result which he interpreted as evidence for at least two stages in reading: a basic mechanics stage which is not highly related to intelligence and a higher-level comprehension stage which is:

> Since the inter-correlations among reading tests were as high in the lower grades as in the higher, the increasing correlation with mental age may be interpreted to mean that intelligence, as measured by Stanford-Binet shows itself only when the mechanics of reading are fairly well mastered [Gates, 1921, p. 458f].

In a later study (Gates, 1926), he examined the relationship between reading ability and the perception of words, geometric forms, and digits. Although the perception of words correlated at a relatively high level with silent reading (even with IQ removed) perception of geometric forms and digits did not. Furthermore, the correlation of word perception with form or digit perception was low. The implications of this study for prereading training are obvious, yet are still ignored in many reading readiness programs which concentrate on identification and matching of geometric forms.

These correlational studies in the twenties led in the thirties to attempts by Gates and others to develop tests for predicting reading success. Wilson and Flemming (1938) and Gates, Bond, and Russell (1939) explored the predictive value of such abilities as oral vocabulary, intelligence, letter name knowledge, and visual perception for end of first grade reading success. In contrast to interpretations given many years later by reading specialists, neither study found letter name knowledge to be the best single predictor of later reading success. In comparing the results of these two studies, Gates, Bond, and Russell (1939) concluded that "The most useful reading readiness tests are tests of ability clearly involved in learning to read [p. 29]." Similar studies of predictive tests have continued until the present day (Durrell, 1958; Weiner and Feldmann, 1963; deHirsch, Jansky, & Langford, 1966), although any contribution of such studies either to classroom practice or to a basic understanding of reading is difficult to discern.

V

THE DARK AGES

The period between Huey's text in 1908 and the re-entry of psychologists into reading research in the late 1950's was not a total void; research on basic processes did continue. In several areas, including eye movement studies, major contributions were made. The work of Gates and his colleagues, of Tinker, and of Buswell, Judd, and others at the University of Chicago kept interest in reading research alive. But in general, few psychologists would confess during this period to be working on reading. Summed over the entire period, the total contribution to our understanding of the reading process was small in comparison to the output up to 1908, and minuscule when considered relative to the number of psychological studies reported in each period. The reasons for this are strongly tied to the evolution of psychology in the twentieth century and to the unique position which reading has taken in American society.

By 1910 psychology no longer doubted its right to exist as an independent discipline, but still felt it necessary to concentrate on basic research to secure its inclusion among the sciences. This attitude led to a retreat from the applied areas, especially from those like reading, which were tied to school curricula. In addition, the advent of behaviorism led to a decline in interest in what happened between the input and output stages in perception and learning. Consequently, reading was left to the educators and to some degree to the educational psychologists, who by 1910 were distinguishable from psychologists. These people were by training and orientation concerned primarily with the realities of the classroom: curricula, teacher training, textbooks, teaching methods, and tests. While the psychologist remained in his laboratory, the educator and educational psychologist operated closer to the front lines. They were pressed for procedures for teaching reading, regardless of what evidence they might possess to justify their recommendations. In this there was no choice, since the school could not close down while the investigation went on. Coinciding with the retreat of psychologists from applied research was the enormous expansion of American education that started just before the end of the nineteenth century.

> Public education, that traditional avenue of opportunity, was going through a phenomenal expansion that made any previous stage of development seem slow. By 1910 the coveted high-school diploma was accessible to all except the poorest of those living in the least settled areas.

> West of the Appalachians, the land grant colleges were making even a college degree nothing spectacular for the child of a moderately successful farmer [Goldman, 1956, p. 35].

With the prohibitive costs removed, higher education was available for all--and especially the millions of new immigrants who arrived in America in the late nineteenth and early twentieth centuries. These new citizens saw education as an opportunity for their children to rise out of economic and social destitution. The only barrier that stood in the way was success in school subjects, of which reading was the first and most important. Failure here meant failure forever; tutors and private schools were not within their means, nor was there a comfortable family job or position of political patronage to fall back on.

The net result was (and still is) that the school system, particularly the teaching of reading, is constantly scrutinized by the child-rearing public. When a real or imagined deficiency is detected, a collective outcry results. To relieve this pressure, American educators have turned not to research and testing to find out why so many children have trouble learning to read, but to new methods with the hope of stumbling on a cure-all. It should be no surprise, therefore, that among those who have influenced the teaching of reading in the last 80 years have been a colonel, a doctor, and a printer.[8]

Another factor that has strongly influenced reading research during the last 45 years at least, as it has all educationally related studies, is funding. Educational research was never heavily funded prior to the passage of the Cooperative Research Act in 1954, and from the onset of the Depression until the late 1950's research support was very difficult to obtain, especially for theoretical work. The Works Projects Administration and several other agencies set up during the Depression supported research at colleges and universities, but tended to favor projects that employed large numbers of workers, such as normative studies of vocabulary or articulation ability. Communication of researchers across disciplines was also greatly reduced during this period, leading to a near stagnation of the field for at least

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[8] Francis Wayland Parker, who reached the rank of colonel during the Civil War, retired from the military shortly after the cessation of hostilities to resume teaching elementary school. He originated the "Quincy System" for teaching reading, which Dewey transformed into the whole-word method.

Joseph Mayer Rice practiced medicine in New York before turning to education. His observations on the teaching of reading, reported first in The public school system of the United States (1893), brought national attention to the whole-word method.

Sir James Pittman, who was concerned with the printing trade in England, designed the Initial Teaching Alphabet (i.t.a.) and was prominent in securing passage of a bill which authorized testing i.t.a. as a means for teaching reading.

30 years. These conditions were aptly summarized in a recent NIE summary of federal support for educational research.

> The fifteen or twenty years prior to 1955 was a period of decline. Education research and development activities were largely conducted by faculties of schools of education, supported by university general funds and modest assistance from private foundations. The performers operated in virtual isolation from the other academic disciplines and, therefore, from much of the intellectual leadership in the social sciences. Partly as a consequence of this isolation, education research and development in the thirties and forties was generally lacking in vigor and intellectual power and had little effect on the practice of education [Building Capacity for Renewal and Reform, 1973, p. 11].

VI

RE-EMERGENCE OF READING RESEARCH

In the late 1950's, psychologists, linguists, and other trained researchers, encouraged by federal funding for basic research related to the improvement of education, returned to the study of reading. Most notable of the studies done at the beginning of this revival are those produced by the interdisciplinary team at Cornell University, which later evolved into Project Literacy. The first group of these studies is collected in Levin et al. (1963), and includes work on letter recognition, letter-sound correspondences, children's abilities to segment words into separate sounds, and a variety of other topics related to perception and learning.[9] Later studies concentrated on most of these same topics, plus the areas of comprehension, oral reading errors, and the eye-voice span. The impetus for this renewed interest was the Cooperative Research Act of 1954, which authorized the Commissioner of the U.S. Office of Education to enter into "contracts or jointly financed cooperative arrangements with universities and colleges and state educational agencies for the conduct of research, surveys, and demonstrations in the field of education [An Act to Authorize Cooperative Research in Education, 1954]."

From its inception in 1867 to the enactment of the Cooperative Research Act, the Office of Education had little influence on the direction of educational research. Its main concerns, as outlined in its enabling legislation, were the collection of educational statistics and dissemination of information on school practices. But the Cooperative Research Act changed this pattern dramatically; by 1963 the Office of Education was expending 14 million dollars on research, and by 1972, 130 million dollars for research and development combined (Building Capacity for Renewal and Reform, 1973, pp. 8-13). During this same period the National Science Foundation, the Office of Child Development, and the National Institutes of Health were making increasingly larger grants for reading-related research. In 1972 the National Institute of Education was founded, with the goals (among others) of strengthening the scientific and technological foundations of education, and building an effective educational research and development system. Since its creation, NIE has given a high priority to reading research; however, its commitment to ongoing development projects inherited from the Office of Education and the

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[9] The background of Project Literacy is described in Levin, 1966.

Office of Economic Opportunity, and its failure to win substantial financial backing from the Congress have limited the funds available for basic studies.

VII

MINOR CONTRIBUTIONS

Several disciplines outside of psychology and education have become involved in reading research, including ophthalmology, typography, and linguistics. The contributions of these areas have been small, but linguistics, for reasons that are not altogether obvious, has had an influence far larger than one would expect. The most important of these contributions have been indirect ones; for example, explorations of specific components of language, such as phonology and syntax, have provided basic information for selecting sentence forms for textbooks and test materials, and for distinguishing reading errors from dialect and idiolect differences. But many linguists have attempted to become more directly involved in reading and in the frequent controversies over instructional methodology and materials. The first linguist to do this was Bloomfield, who became interested in reading at a time when the whole-word method, though still widely used in the American school system, was showing signs of obsolescence. He conducted no research on reading, on any component of the reading process, or on the materials employed in teaching. Instead, he wrote a single article on the teaching of reading (Bloomfield, 1942) and developed 76 lists of monosyllabic words with regular spellings, interspersed with reading exercises. These latter materials, developed by Bloomfield to teach reading to his two sons, were expanded by Barnhart during and after Bloomfield's lifetime, and finally published with an expanded version of the 1942 essay (Bloomfield, 1961). Nevertheless, Bloomfield had a major influence in the years following his death in 1949 on reading instruction and in part on applied reading research, due primarily to his reputation as America's foremost linguist. Part of his influence derives from his attempt to base reading instruction on the elements of speech and the relationship these elements have to units of writing. In the same direct and logical language that distinguishes his linguistic writings, Bloomfield summarized types of writing systems, the phonemic nature of speech, and the advantages of an alphabetic writing system. He then tore into the word method and its two competitors, phonics and ideational reading (the sentence method), laying bare the incompatibility of these procedures with the realities of writing and speech.

In his criticisms of the teaching methods of his day (assuming that these methods were practiced as Bloomfield reported them), there is little that an objective observer could take issue with. But in the conclusion of this essay, where Bloomfield presents his own

procedure for teaching reading, he abandons logic and objectivity for dogmatism, which unfortunately for the unsuspecting reader, is not distinguished from supportable material. Bloomfield claims that his approach to reading instruction is based upon the facts which he has presented on the preceding pages but then proceeds to make psychological pronouncements that are justified neither in the preceding pages nor in any of his other writings. The first of these concerns letter recognition, which is the first step in his system. This is to be taught using the letter names as responses. "The conventional responses to the sight of the letters are their names. . . . There is not the slightest reason for using any other response [1961, p. 35]." But there were differing opinions on this matter even in Bloomfield's time, and there is today a continuing controversy over the value of letter names for initial reading instruction (Venezky, 1975). Two other debatable principles which Bloomfield advocated concern the piecemeal presentation of multiple responses for the same phoneme, now questioned by Levin and Watson (1963) and Williams (1968), and the use of nonsense syllables. Controversy over the latter issue, unfortunately, has seldom gone beyond the pitting of one opinion against another. But in spite of these drawbacks to Bloomfield's system, his emphasis on understanding writing and speech were significant contributions to his time.

Following Bloomfield's lead, a number of American linguists became involved in reading, including Fries (1962), Smith (1956), and Hockett (1963). Fries' contributions were the most far reaching, including a text, Linguistics and Reading, and a variety of articles drawn from this text. But, like Bloomfield, he neither engaged in formal research related to reading nor concerned himself with the psychological problems of learning beyond what common sense or intuition would produce. This failure has characterized most linguists' approach to reading: to overemphasize the linguistic basis of reading (or, to be more accurate, its linguistic content) at the expense of the learning process.

VIII

EPILOGUE

The history of reading research from its origin in the nineteenth century through its revival in the late fifties and early sixties of this century is a difficult history to follow, if for no other reason than the difficulty of deciding what is reading or reading-related research and what is not. A broad, inclusive view would sweep in practically the entire body of work on perception and cognition, to say nothing of assessment and instruction studies, while the narrower view as reflected here restricts membership to those efforts aimed clearly at the reading process itself. For various reasons little space has been devoted to the development of reading tests and of instructional procedures. Much of this work does not qualify as research and much of what might qualify is too shoddy to merit inclusion. Studies on other topics like the development of word recognition ability are excluded not because of their quality, but because none were done prior to the last few years.

The revival of interest by experimental psychologists in basic reading research has already led to interesting and important results in visual processing. Yet certain conditions under which the current work is being done may limit its potential for improving reading instruction, or even for gaining a clearer understanding of the reading process. In most of the present-day work, reading is viewed as a means to an end. Much of the work on word recognition, for example, is aimed towards the construction of information processing models for visual processing, rather than towards reading models per se. Although the results of such endeavors clearly contribute to a better understanding of reading, the lack of focus on reading often leads to ignoring their practical implications or to ignoring the relationship of laboratory-derived processes to what occurs in the reading environment. In this respect, the better work today mirrors that of 80 years ago.

In the communication of research results to other researchers and to reading specialists, conditions today are much less favorable than 80 years ago. At the turn of the century, reading controversies were a prominent part of the psychological literature. The journals were fewer in number--The Psychological Review and the American Journal of Psychology in the United States, Mind in England, and Philosophische Studien and one or two others in Germany and France. Experimenters in different laboratories were aware of each other and generally in frequent communcation; and competition at a professional level, much like that which the Double Helix (Watson, 1968) reveals

for the present-day field of genetics, was common. Today most reading research is fragmented and isolated--even though professional organizations have attempted to improve communication through special interest groups, and governmental funding agencies have attempted to bring researchers together to discuss their work or to draft priority lists for research funding.

Finally, concern must be expressed for the rationale which most funding agencies now give for support of basic reading research--improving reading instruction. Although some knowledge about the reading process is needed for improving instruction, the claim that all basic research can do this is bound to crack under even the most casual scrutiny. Investigations of letter recognition, for example, are definitely part of basic reading research, and a thorough understanding of how letters are discriminated would be valuable information to have. But it would not improve reading instruction because no major problem has ever been identified with letter discrimination.[10] The issue is not the support of letter discrimination studies, but the justification of such support under the guise of instructional improvement. Certain basic studies in reading, just as in theoretical mathematics, merit support for their potential contribution to fundamental knowledge about human abilities.

The other side of this issue, however, is the diversion of instructional improvement funds to research that has a low potential for affecting classroom practice. Considerable research is needed to understand how reading might be taught more effectively, yet it is naive to assume that such research will result from heavy funding of experimental psychologists who are not committed to practical applications in reading. If reading research is to influence instruction, then more experimental psychologists will have to be persuaded to interact professionally with educational planners and developers, and to concern themselves with the practical side of reading. There is little chance that articles in professional publications will be sufficient to influence practice, or that practitioners will find the time and training to do good basic research.

Nevertheless, some basic research, even in a fragmented form, is better than no basic research, and therefore should be encouraged. But how long the current revival-of-sorts will last is difficult to predict; it will not fail, however, for lack of worlds to conquer. Almost all of the problems attended to by Cattell, Quantz, Erdmann, Dodge, and Huey remain unresolved today: control of eye movements, the strategies involved in word recognition, the amount and types of overlapping processes, the role of subvocalization, the nature of the eye-voice span, and--of course--the optimal methods for reading instruction. Perhaps the most significant contributions made in the last fifteen years were in rediscovering important works from the nineteenth and early twentieth centuries and in focusing attention on obtaining ". . . a deep understanding of the discipline to be

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[10] Orientation confusions are excluded here.

taught and the nature of the learning process involved [Gibson, 1965, p. 1072]."[11]

[11] A more pessimistic view can be gleaned from a recent lament by the editors of the Reading Research Quarterly (Summer, 1971. preface): "Of the many manuscripts received in a year, there are seldom more than enough studies that receive the endorsements of reviewers to fill the issues of the RRQ." On the relationship of research to practice, see Levin (1966) and Singer (1970).

REFERENCES

Anderson, I. H., & Dearborn, W. F. The psychology of reading. New York: Ronald, 1952.

Barzun, J., & Graff, H. F. The modern researcher. New York: Harcourt, Brace, Jovanovich, 1957.

Bloomfield, L. Linguistics and reading. Elementary English Review, 1942, 19, 125-130, 183-186.

Bloomfield, L. Teaching children to read. In L. Bloomfield and C. L. Barnhart (Eds.), Let's read: A linguistic approach. Detroit: Wayne State University Press, 1961. Pp. 19-42.

Book, W. F. The psychological skill with special reference to the acquisition of typewriting. University of Montana Publications in Psychology, 1908.

Bryan, W. L., & Harter, N. Studies in the telegraphic language, the acquisition of a hierarchy of habits. Psychological Review, 1899, 6, 345-375.

Buchner, E. F. Review of E. B. Huey: The psychology and pedagogy of reading. The Psychological Bulletin, 1909, 6, 147-150.

Building capacity for renewal and reform. Washington, D. C.: National Institute of Education, December 1973.

Buswell, G. T. An experimental study of the eye-voice span in reading. Supplementary Educational Monographs, No. 17. Chicago: Department of Education, University of Chicago, 1920.

Butsch, R. L. C. Eye-movements and the eye-hand span in typewriting. Journal of Educational Psychology, 1932, 23, 104-121.

Cattell, J. M. The time it takes to see and name objects. Mind, 1886, 11, 63-65.

Cattell, J. M. Mental tests and measurements. Mind, 1890, 15, 373-380.

Cattell, J. M. James McKeen Cattell: Man of Science, 1860-1944. Lancaster, Penn.: Science Press, 1947. 2 vols. (a)

Cattell, J. M. Über die Zeit der Erkennung und Benennung von Schriftzeichen, Bidern and Farben. Philosophische Studien, 1885, 2, 635-650. Trans. J. M. Cattell. 1947, 1, 13-25. (b)

Dearborn, W. F. The psychology of reading. Archives of Philosophy, Psychology, and Scientific Methods, 1906, 1, 7-132.

Dearborn, W. F. Professor Cattell's studies of reading and perception. Archives of Psychology, 1914, 30, 34-45.

deHirsch, K., Jansky, J. J., & Langford, W. S. Predicting reading failure. New York: Harper & Row, 1966.

Dockeray, F. C. The span of vision in reading and the legibility of letters. Journal of Educational Psychology, 1910, 1, 123-131.

Dodge, R. Visual perception during eye movement. Psychological Review, 1900, 7, 454-465.

Dodge, R. The illusion of clear vision during eye movement. Psychological Bulletin, 1905, 2, 193-199.

Dodge, R. An experimental study of visual fixation. Psychological Review Monograph Supplements, 1907, 8, (No. 4).

Duker, S., & Nally, T. P. The truth about your child's reading. New York: McGraw-Hill, 1956.

Durrell, D. D. First grade reading success study: A summary. Journal of Education, 1958, 140, 2-6.

Erdmann, B., & Dodge, R. Psychologische Untersuchungen über das Lesen. Halle: N. Niemeyer, 1898.

Fairbanks, G. The relation between eye movements and voice in the oral reading of good and poor silent readers. Psychological Monographs, 1937, 48(Whole No. 3).

Fries, C. C. Linguistics and reading. New York: Holt, Rinehart, & Winston, 1962.

Gates, A. I. An experimental and statistical study of reading and reading tests. Journal of Educational Psychology, 1921, 12, 303-314, 378-397, 445-464.

Gates, A. I. A study of the role of visual perception, intelligence, and certain associative processes in reading and spelling. Journal of Educational Psychology, 1926, 17, 433-445.

Gates, A. I., Bond, G. L., & Russell, D. H. Methods of determining reading readiness. New York: Bureau of Publications, Teachers College, Columbia University, 1939.

Gibson, E. J. Learning to read. Science, 1965, 148, 1066-1072.

Gibson, E. J., & Levin, H. The psychology of reading. Cambridge, Mass.: M.I.T. Press, 1975.

Goldman, E. Rendezvous with destiny. (Rev. ed.) New York: Vintage Press, 1956.

Goldscheider, A., & Muller, R. F. Zur Physiologie and Pathologie des Lesens. Zeitschrift für Klinische Medicin, 1893, 24, 131-167.

Gray, W. S. Summary of investigations relating to reading. Supplementary Educational Monographs, No. 28. Chicago: Department of Education, University of Chicago, 1925.

Griffing, H. On the development of visual perception and attention. American Journal of Psychology, 1896, 7, 227-236.

Hamilton, F. M. The perceptual factors in reading. Archives of Psychology, 1907, 9, 1-56.

Harris, Louis & Associates, Inc. Survival literacy study. Study No. 2036. Washington, D. C.: National Reading Council, 1970.

Hockett, C. F. Analysis of English spelling. In H. Levin and E. J. Gibson (Eds.), Basic studies in reading. Ithaca, N. Y.: Cornell University, 1963.

Holt, E. B. Eye movement and central anaesthesia. Harvard Psychological Studies, 1903, 1, 3-45.

Huey, E. B. The psychology and pedagogy of reading. New York: Macmillan, 1908. (Republished: Cambridge, Mass., M.I.T. Press, 1968.)

Javal, L. E. Essai sur la physiologie de la lecture. Annales D'Oculistique, 1878, 82, 242-253.

Judd, C. H., & Buswell, G. T. Silent reading: A study of the various types. Supplementary Educational Monographs. Chicago: Department of Education, University of Chicago, 1922.

Levin, H. Reading research: What, why, and for whom? Elementary English, 1966, 41, 138-147.

Levin, H., & Watson, J. The learning of variable grapheme-phoneme correspondences. In H. Levin et al. (Eds.), A basic research program on reading. Final report. Cooperative Research Project No. 639. Ithaca, N. Y.: Cornell University, 1963.

Levin, H. et al. A basic research program on reading. Final report. Cooperative Research Project No. 639. Ithaca, N. Y.: Cornell University, 1963.

Mathews, M. M. Teaching to read, historically considered. Chicago: University of Chicago Press, 1966.

Mead, C. D. Silent versus oral reading with one hundred sixth-grade children. Journal of Educational Psychology, 1915, 6, 345-348.

Morgan, W. P. A case of congenital word-blindness. British Medical Journal, 1896, 2, 1612-1614.

Oberhaltzer, E. E. Testing the efficiency in reading in the grades. Elementary School Journal, 1915, 15, 313-322.

Pillsbury, W. B. The reading of words: A study in apperception. American Journal of Psychology, 1897, 8, 315-393.

Pinter, R. Inner speech during silent reading. Psychology Review, 1913, 20, 129-153. (a)

Pinter, R. Oral and silent reading of fourth-grade pupils. Journal of Educational Psychology, 1913, 4, 333-337. (b)

Pyke, R. L. Report on the legibility of print. Special Report, Series No. 110. London, England: Medical Research Council, 1926.

Quantz, J. O. Problems in the psychology of reading. Psychological Review Monograph Supplements, 1897, (No. 1).

Quantz, J. O. Problems in the psychology of reading. Psychological Review, 1898, 5, 434-436.

Reading Research Quarterly, 1971, 7, i.

Rice, J. M. The public school system of the United States, 1893. (Republished: New York. Arno Press, 1969.)

Romanes, G. J. Mental evolution in animals. New York: Appleton, 1883.

Ruediger, W. C. The field of distance vision. Archives of Psychology, 1907, 5.

Schlesinger, I. M. Sentence structure and the reading process. The Hague: Mouton, 1968.

Secor, W. B. Visual reading: A study in mental imagery. American Journal of Psychology, 1900, 11, 225-236.

Singer, H. Research that should have made a difference. Elementary English, 1970, 47, 27-34.

Smith, H. L., Jr. Linguistic science and the teaching of English. Cambridge, Mass.: Harvard University Press, 1956.

Smith, N. B. American reading instruction. Newark, Del.: International Reading Association, 1965. (First issued, 1934.)

Spencer, H. The visible word. (2nd ed.) New York: Hastings House, 1969.

Summers, E. G. Reading research literature: Identification and retrieval. Reading Research Quarterly, 1968, 4, 5-48.

Tiffin, J. Simultaneous records of eye movements and the voice in oral reading. Science, 1934, 80, 430-431.

Tinker, M. A. The study of eye movements in reading. Psychological Bulletin, 1946, 43, 93-120.

Tinker, M. A. Time taken by eye movements in reading. Journal of Genetic Psychology, 1936, 48, 468-471.

Uttal, W. R., & Smith, P. Recognition of alphabetic characters during voluntary eye movements. Perception and Psychophysics, 1968, 3, 257-264.

United States Congress, An Act to Authorize Cooperative Research in Education. Public Law 531, Chapter 576, 83rd Congress, 1954.

Venezky, R. L. The curious role of letter names in reading instruction. Visible Language, 1975, 9, 5-26.

Vernon, M. D. The experimental study of reading. Cambridge, England: Cambridge University Press, 1931.

Watson, J. The double helix. New York: Atheneum, 1968.

Weiner, M., & Feldmann, S. Validation studies of a reading prognosis test for children of lower and middle socio-economic status. Educational and Psychology Measures, 1963, 23, 807-814.

Whipple, G. M. Vocabulary and word-building tests. Psychological Review, 1908, 15, 94-105.

Wiggins, R. H. Effects of three typographical variables on speed of reading. Journal of Typographic Research, 1967, 1, 5-18.

Williams, J. P. Successive versus concurrent presentation of multiple grapheme-phoneme correspondences. Journal of Educational Psychology, 1968, 59, 309-314.

Wilson, F. T., & Flemming, C. W. Correlations of reading progress with other abilities and traits in Grade 1. Journal of Genetic Psychology, 1938, 53, 33-52.

Zeitler, J. Tachistoskopische Untersuchungen über das Lesen. Philosophische Studien, 1900, 16, 380-463.